COST AVOIDANCE TECHNIQUES

FOR

RC-135 PROGRAM FLYING TRAINING

GRADUATE RESEARCH PAPER

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Abstract

The process of training a student from their first sortie through their flight evaluation is called Program Flying Training (PFT). Initial Qualification Training (IQT), conducted by aircraft Flying Training Units (FTUs), provides operational squadrons with new aircrew.

With a high demand, FTUs are under constant pressure to complete as much training as possible per day. These demands become even more difficult with the current states of military aircraft and DoD budgets: Air Force aircraft are not getting any younger and flying hour programs are not receiving more hours. Simply put, FTUs are asked to produce at an equal or greater level every year despite reduced resources. This research seeks to determine where limited resources are best allocated to produce the same or greater number of qualified aircrew at a reduced cost. The method involves using Partial Mission Trainers (PMTs) where possible and giving commanders the flexibility to cancel sorties that are deemed inefficient.

This analysis will examine RC-135 flying operations at Offutt AFB, Nebraska. Flying data from the 338th Combat Training Squadron (RC-135 FTU) is used to determine where inefficiencies occur within the flying schedule. Once identified, the flying schedule can be "reflowed" to incorporate the use of PMTs. Evidence exists showing that commanders can cancel specific sorties without losing significant PFT productivity. By eliminating inefficient sorties and rescheduling them at a later date when more students are available, FTUs can improve their PFT productivity.

To my spouse, Molly, and family

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John J. Isacco

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I. Introduction

Background

The 338th Combat Training Squadron (CTS) directs Initial, Requalification and Instructor Qualification Training for all RC-135 aircrew. As one of the largest Flying Training Units (FTUs) in Air Combat Command (ACC), the 338th CTS tracks approximately 60 students daily. The process of training students from their first sortie through their flight evaluation is called Program Flying Training (PFT).

The 338th CTS will fly two types of sorties. One is called a Full Mission Trainer (FMT) while the other is a Partial Mission Trainer (PMT). FMTs (as the name implies) normally contain a full RC-135 crew. FMTs are essential to train all aircrew in the RC-135 career field. It is not unusual to have more than pilots and navigators on board. For example, flight engineers, air refueling operators ("boom operators") and loadmasters are common throughout the Air Force. PMTs consist of only pilots and navigators. PMTs are also a RC-135 airframe but include seats for only pilots and navigators.

FMT sortie profiles normally last about seven hours. FMTs will takeoff, orbit and then return to practice landings. PMTs typically last under five hours. PMTs conduct a similar profile with several landings but normally fly a one-hour navigation leg instead of an orbit. Both FMTs and PMTs will conduct air refueling when scheduling permits. Since pilots and navigators conduct several takeoffs and landings, PMTs enable the flight deck to complete additional training without using a FMT and placing extra stress on operational RC-135 aircraft.

Students are loaded onto each flight and count as PFT. For example, if there are two students on a PMT (1 pilot upgrading to aircraft commander and 1 pilot going through initial co-pilot qualification), the sortie will show “2 PFT”. A sortie with “12 PFT” is equivalent to an FMT with 12 students. The max possible PFT events for one FMT sortie are 20 although 10-12 is usually the goal. A PMT usually has two to three PFT events. PMTs will have a maximum of three students. This is summarized in Table 1.

Table 1 - Max PFT per Sortie

Trainer Type	Max PFT	Normal Amount
FMT	20	10-12
PMT	3	2-3

If a student is “effective”, they move on to the next event in their syllabus. Students are “ineffective” for a multitude of reasons (weather, tanker cancels and the student needed air refueling, etc). In this example, the result of a PMT might be “0 of 2 PFT complete”, “1 of 2 PFT complete”, or “2 of 2 PFT complete”.

To meet aircrew graduation timelines, the 338th needs to complete a certain number of PFT per day. The 338th CTS tracks their PFT using three different methods. Each method provides a unique metric. Together, the three methods present an overall picture of PFT progression and the overall health of RC-135 aircrew qualification training.

Method 1 – PFT Needed Per Day

Students go through their training on a "MissionPlan-Fly-Debrief-MissionPlan, etc" schedule. Day 1 is dedicated to mission planning, day 2 is the sortie and day 3 is for debrief and study review. This process is repeated on day 4 and continued until the student completes his/her flight evaluation. Due to weather and other delays, the average student flies once every 3.6 days (Nichols, 2013). For example, if there are currently 63 students in training, the 338th CTS will need to accomplish 17.5 PFT per day to keep everyone on the 3.6-day cycle.

$$63\ students\ \div 3.6\frac{days}{PFT} = 17.5\frac{PFT}{day} \tag{1}$$

Method 2 – Class Timelines

A second method to track PFT progress looks closely at each IQT class. IQT is divided into two phases. Stage 1 includes academics and flight simulators. Stage 2 includes the actual flying. A typical class of IQT students will complete their academic and simulator portion on time; weather or maintenance delays do not influence these events. Once in the flying stage, the 338th CTS closely follows students to ensure an on-time graduation. For example, if there are four students upgrading to Aircraft Commander (AC) and each student requires seven sorties to graduate, supervisors can determine an approximate date that a student should graduate. A chart shows class progression and highlights specific delays to a commander. Once highlighted, a commander can determine if extra sorties are necessary to reduce these delays.

Method 3 – Projected Graduation Dates

A third method combines method's 1 and 2 and projects a current class graduation date. Based upon data from the first two methods, the 338th CTS can estimate class graduation dates and compare them to the expected timeline. This is different from method 2 in that we are looking at an entire class's progression versus one specific aircrew position.

On a typical day, an aircrew may preflight an aircraft and experience a delay or ultimately have to move to a spare aircraft. When this happens, some students may come off the flight because the delayed takeoff has eroded their training to the point where they would not be effective and progress in the syllabus. An aircrew might begin the day with the potential for 12 PFT events, experience several delays, and eventually launch after approx 5-6 hrs with six students capable of completing their sortie. Thus, the best scenario at takeoff would be "6 of 12 PFT" complete. The ineffective six students may remain on the flight but will not progress in the syllabus and thus have to repeat the sortie. While the "free sortie" can be of benefit to a student, it comes at a cost to the 338th CTS, as it is less efficient with its PFT and flying hours than if all students were effective.

If the emphasis were solely on the absolute number of PFT events completed and students graduated per year, any amount of PFT completed per day would be beneficial. This thought process is similar to "if we can get 1 PFT done, then it's worth flying this training sortie". On occasion, it is necessary to launch a sortie with a below average number of PFT. A student on the sortie may need to fill a deployment slot and, in order to deploy, would need to complete training before a definite date. However, this issue is rare and does not apply to most students.

Typically, PFT is analyzed on a per day basis. However, PFT is rarely tracked at the hourly level. There is potential to track PFT on a per hour cost basis to determine if there are significant means to save on flying training operations. At some point, it may be more cost effective to reschedule students than to eventually launch a delayed sortie, especially in a world of decreased flying hours and smaller budgets. Essentially, when delays occur, commanders have a choice. They can choose to fly with 50% PFT rate or attempt to reschedule with the hope of a higher PFT rate. The choice is not as simple as comparing absolute percentages. Flying hours constraints, weather forecasts and class timelines may make it necessary to fly an inefficient sortie that day and accept the lost training. Keep in mind, a commander cannot reschedule every delayed sortie. Thus, if he/she chooses to reschedule a Monday sortie that had 50% PFT, he/she loses a chance to reschedule a future sortie even though it might experience similar delays and lose more than 50% PFT. If the commander can identify the most inefficient sorties in advance and replace them in a judicious process, the cost and hours savings could be significant.

Problem Statement

The purpose of this research is to analyze PFT at the hourly level and determine if a metric can be developed to aid commanders in determining when a sortie is inefficient and should be rescheduled or cancelled.

Research Objectives

To understand how PFT per hour can aid in improving flying efficiency, the following research objectives are listed:

- Using pilot and copilot student data, determine if there is a statistically significant difference in number of training events between PMTs and FMTs.
- Establish a connection between cost per flying hour (CPFH) and PFT per sortie.
- Determine if there is a minimum PFT per hour (PFT/Hr) metric that, if not met, commanders should give serious consideration towards cancelling or re-scheduling the sortie.

II. Literature Review

Overview

In this chapter, a general overview describes the current cost, maintenance and flying hour climate. Additionally, a statistical test shows how 338th CTS data is analyzed in chapters 3 and 4.

Airlines have continually shown the ability to make incremental changes resulting in enormous annual savings from (small daily changes). Based on these case studies and the current fiscal climate, there is an increased emphasis on each Air Force sortie. Ultimately, there should be more emphasis on determining exact metrics for flying efficiency with respect to PFT.

Air Force Flying Climate

With such a high demand, the 338th CTS is under constant pressure to complete as much PFT as possible per day. Furthermore, the 338th CTS is the basic pipeline that provides operational RC-135 squadrons with new aircrew. Without a steady inflow of new aircrew, squadrons are under more stress as they strive to meet current and new operational demands.

These demands become even more difficult against the current states of military aircraft and DoD budgets. Simply put, the Air Force's aircraft are not getting any younger. Towards the end of the Vietnam War, the average age of military aircraft was 9 years. Over 30 years later, in 2007, that average age increased to 24 years, with even higher current projections for future years (Montgomery, 2007). With respect to the RC-135, age has an even greater impact. Built in the 1960's, RC-135s have covered tours over Vietnam and Operations Southern/Northern Watch. Over this time, some aircraft have even passed the 50,000 flight-hour mark (Bryan, 2008).

When the current costs and demands are considered, the numbers paint a more difficult picture. From 1996 to 2006, maintenance costs increased 38% (Montgomery, 2007). Although the recent budget debates at the federal level garner most of the attention, Air Force flying hours have been steadily declining for some time. For example, in 2005, Pacific Air Forces (PACAF) cut approximately 9,000 hours from its training. This cut was roughly 9% of its total flying budget (Schanz, 2008).

Despite the decline in flying hours and rising costs, the Air Force's flying hour program (FHP) can almost work against a wing's flying operations. Typical flying data reflects if an Air Force wing has exceeded or "under flown" their monthly flying hour allotment. A common belief is that "under-flying" your monthly allotment is poor management. Russell Rhea, a retired Navy Captain with over 20 years in the logistics field states, "In the traditional world of management, we are enamored with our red, yellow and green metrics, leading to the ever-present 'self-preservation' paranoia about going forward to management 'red'. Red is bad, green is good" (Rhea, 2007). No one wants to explain why his or her wing is not meeting the monthly or yearly flying allotment. Simply put, it is easier to meet a flying hour goal than to explain otherwise.

When weather and maintenance delays force sorties to cancel in the beginning of the month, the reaction is to "catch-up" because the wing is behind on flying hours. However, there may be no need to "catch-up" if all training requirements are currently satisfied. Unfortunately, FHP allotment and training progress are rarely tied together

(Spencer, 2009). In many cases, if training metric is tied to FHP, production could be increased.

Incremental Changes

The issues faced by the 338th CTS are not different from the rest of the Air Force. Demand, in the form of required PFT, has remained steady despite more strict constraints of costs, time and money. To meet demand against these constraints, it is imperative to identify savings, even if at the smallest level. A savings of one PFT done on a weekly basis, although seemingly insignificant, could have enormous impact over time. Even the smallest regular cost savings could create immense savings. The commercial airlines provide several examples in which incremental savings translate into significant results.

Alaskan Airlines calculates that by reducing taxi time by one minute per flight, it could save 500 minutes daily (Mouawad, 2013). 500 minutes is roughly the equivalent amount of time an average Alaskan Airline plane flies each day. In effect, by saving 500 minutes daily, the airline is able to generate an extra plane. By freeing up a plane, Alaskan Airlines estimates it could create an extra $25 to $30 million in revenue per year (Mouawad, 2013).

The FAA, FedEx, Delta Air Lines and AirTran Airways conducted a study involving over 600 flights. By reducing the descent time by only a couple of minutes, commercial aircraft could save anywhere from 300-1,000 pounds for each arrival (Toon, 2009). This translates to roughly 45-150 gallons of fuel per flight. At a cost of $3 per gallon, the savings could add up to hundreds of dollars per flight. While a few hundred dollars may seem insignificant in a billion dollar industry, the savings for Delta and

AirTran could be enormous as it conducts several flights per day from Atlanta's Hartsfield-Jackson International Airport (Toon, 2009).

It is easy to apply the above examples to RC-135 training. Suppose Offutt AFB has 40 weeks dedicated to flying operations. Even if the 338th CTS could save one extra PFT per week, the effect over the year could generate multiple crew positions. Table 2 gives an example.

Table 2 - Extra PFT per Week

Flying weeks = 40	**One Extra PFT/Week = 1**	**Total = 40 Extra PFT**

Sample Crew Positions	**Number of Sorties Required**	**Number of Graduates**
Aircraft Commander	8	40/8 = 5
Copilot	8	40/8 = 5
Navigator	7	40/7 = 5+

Air Force Flying Hour Costs

Four variables make up the flying hour program. They are supplies (tools used to repair aircraft), impact card (purchases by maintenance), AVPOL (aviation gas) and depot level reparables (aircraft part supplies) (Dowell, 2013). The current costs of flying one hour at Offutt AFB are shown in Table 3. In FY 2013, regardless of whether a sortie was a FMT or PMT, the cost per flying hour (CPFH) is $7,502. Costs projections decrease through FY 2015 and then move slightly higher in FY 2018. This is largely due to the decrease in the price of AVPOL.

Table 3 - Offutt AFB Cost Per Flying Hour (CPFH)

	OAC	EEIC	MDS	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
FMT	98	Supplies	RC-135V (FMT)	275	317	331	345	361	377
		Impact Card		31	38	39	40	40	41
		AVPOL		6,592	6,318	5,659	5,649	5,686	5,724
		DLRs		604	613	472	488	520	539
				$7,502	$7,286	$6,501	$6,522	$6,607	$6,681
	98	Supplies	RC-135W (FMT)	275	317	331	345	361	377
		Impact Card		31	38	39	40	40	41
		AVPOL		6,592	6,318	5,659	5,649	5,686	5,724
		DLRs		604	613	472	488	520	539
				$7,502	$7,286	$6,501	$6,522	$6,607	$6,681
PMT	98	Supplies	TC-135W (PMT)	275	317	331	345	361	377
		Impact Card		31	38	39	40	40	41
		AVPOL		6,592	6,318	5,659	5,649	5,686	5,724
		DLRs		604	613	472	488	520	539
				$7,502	$7,286	$6,501	$6,522	$6,607	$6,681

Despite decreasing costs, the expense is still significant, especially when considering the Average Sortie Duration (ASD) at Offutt AFB is 6.5 hours (Dowell, 2013). With such high costs, justification of every flight hour is necessary.

Several studies have looked at ASD with the hopes of reducing CPFH. Although it might seem that shorter sortie durations would put less stress on aircraft, studies have shown that decreasing ASD increases CPFH. In 2006, the Air Force Logistics Management Agency (AFLMA) performed a study for Headquarters Pacific Air Forces (PACAF) (Dawson, 2006). Their study concluded, "CPFH will increase as ASD decreases. The analysis indicated reducing ASD can't decrease the cost of aircraft repair parts, which accounts for approximately 70% of the total FHP study" (Spencer, 2009).

In a continued quest to fulfill the required flying hours each month, Figure 1 and

Figure 2 can be useful. For instance, when an aircraft delays for repairs or weather, it may have to adjust its sortie plans and duration. Crew duty day limits, outlined by Air Force Instructions, may preclude an aircrew from flying their full sortie profile. The result is a sortie with a below average or shorter ASD. Based upon the AFLMA study, continued events like these could be a contributing factor towards increased CPFHs. If an emphasis is placed on CPFH, it may be beneficial to cancel a sortie and reschedule for a later date when more training could be accomplished using the full planned sortie duration.

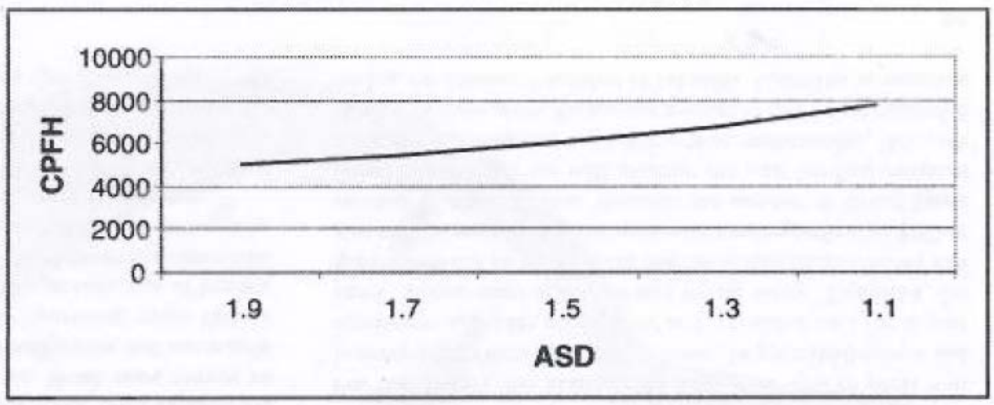

Figure 1 - CPFH Estimates: Variable ASD, Same # of Sorties, Variable Flying Hrs

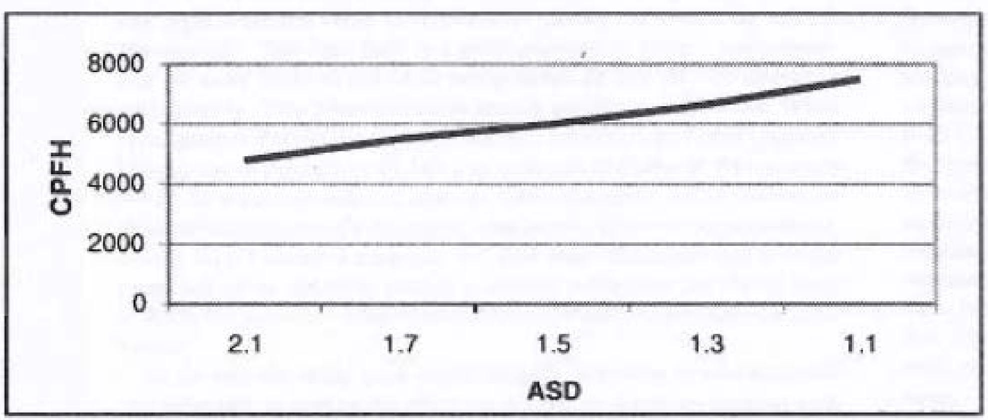

Figure 2 - CPFH Estimates: Variable ASD, Variable # of Sorties, Same Flying Hrs

Cost Savings vs. Cost Avoidance

It is common for the Air Force to refer to a program's benefits in terms of cost savings. While our ultimate objective is to reduce cost (i.e. cost savings), there is a difference between cost savings and cost avoidance.

For example, let us say a commander has 1000 hours to complete his squadron's annual training requirements. Furthermore, in this example, he/she devises a new flying schedule and completes all annual training requirements in 950 hours. To say that he/she "saved" 50 hours would be misleading. The 50 hours, as part of the 1000 hours, has already been allocated to a flying wing. If a squadron does not use these hours, another squadron will. Thus, the flying wing will use the 1000 hour allotment unless other circumstances dictate. This is an example of cost avoidance. The commander has avoided spending over $300,000 (50 hrs x $7,502 CPFH = $375,100). Instead, this money can hopefully be spent on another squadron to complete their annual training.

If this continues on a yearly basis, a flying wing may justify a smaller allotment of flying hours. In this case, as annual budgets are announced, a flying wing may receive a smaller amount of hours. Here, by consistently completing annual training requirements in less time, the Air Force has the flexibility to spend less on a yearly basis. This is an example of cost savings and is critical when facing reduced budgets from Congress.

Currently, costs are not factored into graduation timelines. We are not recommending that costs drive completion dates. However, by including costs into PFT analysis, we might be able to derive a metric to measure squadron efficiency. For this paper, we will focus on cost avoidance as a means to achieve cost savings.

Analysis Of Variance (ANOVA)

The ANOVA test is used to determine if the mean values, which are drawn from samples of the population, are statistically different. Certain assumptions include that all samples are independent and the variances of the populations are equal. The ANOVA produces an F-statistic. The F-statistic helps compare the variances of the populations (Milton, 2003).

The F-test in a one-way ANOVA is used to assess whether the values within a group of data is statistically different from the other groups. For example, suppose we wanted to compare the strength of two electrical wires. Samples are drawn from both population sets. If we can test and show that the variances are statistically different, we can then compare the means to see if they are statistically different. Here, the ANOVA F-test is used to see if one wire is superior to the other (Milton, 2003). Furthermore, a p-value is given. This p-value is compared to the alpha level, designated as α. A p-value less than α means there is a significant difference found in the data set.

III. Methodology

Overview

This chapter describes the origin of the data and provides an explanation of the method used to analyze the data.

Data Source

For analyzing PFT efficiency, the 338th CTS provided a random sample of flying data. The data covered 100 sorties. The data included planned sortie duration, planned PFT for each aircrew position and the actual results. A sample of the data is shown below in Figure 3. The 343rd Reconnaissance Squadron provided CPFH data.

Sched Duration	Actual Show	Actual Toff	Actual Land	Actual Duration	All PFTCount	All PFTEffect
5	1/1/1901 6:30	1/1/1901 8:30	1/1/1901 13:42	5.2	2	2
7	1/1/1901 6:00	1/1/1901 8:15	1/1/1901 15:18	7.1	11	11
5	1/1/1901 16:19	1/1/1901 18:11	1/1/1901 23:20	5.2	2	2
6.9	1/1/1901 7:18	1/1/1901 9:08	1/1/1901 15:49	6.7	11	11
5	1/1/1901 7:00	1/1/1901 8:56	1/1/1901 14:00	5.1	2	2
7	1/1/1901 5:55	1/1/1901 8:11	1/1/1901 15:00	6.8	13	13
5	1/1/1901 16:50	1/1/1901 18:50	1/1/1901 23:51	5	2	2
6.9	1/1/1901 7:04	1/1/1901 9:53	1/1/1901 15:42	5.8	10	7
5	1/1/1901 7:45	1/1/1901 9:30	1/1/1901 14:30	5	2	2
7	1/1/1901 6:25	1/1/1901 9:41	1/1/1901 16:39	7	10	9
5	1/1/1901 16:55	1/1/1901 18:30	1/1/1901 23:42	5.2	2	2
9	1/1/1901 6:07	1/1/1901 7:47	1/1/1901 16:57	9.2	9	9
8	1/1/1901 9:30	1/1/1901 11:16	1/1/1901 18:44	7.5	3	1
6.4	1/1/1901 7:30	1/1/1901 9:24	1/1/1901 15:58	6.6	13	13
7.5	1/1/1901 6:00	1/1/1901 8:00	1/1/1901 15:53	7	17	16
5	1/1/1901 16:30	1/1/1901 18:07	1/1/1901 23:07	5	3	3
6.9	1/1/1901 6:45	1/1/1901 8:51	1/1/1901 15:46	6.9	11	11
5	1/1/1901 8:00	1/1/1901 9:43	1/1/1901 14:48	5.1	2	2
9	1/1/1901 5:47	1/1/1901 7:32	1/1/1901 16:13	8.8	14	14
5	1/1/1901 7:45	1/1/1901 9:50	1/1/1901 14:45	4.9	3	3

Figure 3 - 338th CTS Flying Data

Flying Schedule

Each sortie lists the scheduled duration, scheduled PFT and a PFT breakdown by crew position. The data also included the actual PFT results from each sortie. Dates are not included.

To build a theoretical flying schedule, we created the following methodology to classify a sortie as a FMT or PMT. We will assume a FMT will fly for at least 6 hours or more while a PMT flies for approximately 5 hours or less. Without knowing the actual designation of the sortie, it is difficult to conclude if a sortie of 5.7 hours is a PMT or FMT. A typical FMT would not fly for 5 hours unless there was a ground or weather delay. In these cases, the number of PFT could help determine if a sortie is a PMT or FMT. PMTs are sorties with only pilots and navigators listed and flown fewer than 6 hours. FMTs are sorties with more personnel, regardless of sortie duration. Any sortie flown over 6 hours is an FMT. Table 4 displays this methodology.

Table 4 - Sortie Determination

Sortie Determination		
Duration	**Crew Aboard**	**Sortie Type**
≤ 6 hours	Only pilots and navigators	PMT
> 6 hours	n/a	FMT
n/a	Additional Members	FMT

Next, we reconstructed the data to simulate flying operations. We created a theoretical flying schedule and grouped the sorties by pairs. The first pair is day 1, followed by the next pair on day 2 and so on. Using the criteria above to identify PMT or FMT, the following theoretical, sample schedule is shown in Figure 4.

		Sched Duration	Actual Duration	Sched PFT	Actual PFT	Sched PFT/Hr	Actual PFT/Hr
Mon	PMT	5	5.2	2	2	0.40	0.38
	FMT	7	7.1	11	11	1.57	1.55
Tues	PMT	5	5.2	2	2	0.40	0.38
	FMT	6.9	6.7	11	11	1.59	1.64
Wed	PMT	5	5.1	2	2	0.40	0.39
	FMT	7	6.8	13	13	1.86	1.91
Thur	PMT	5	5	2	2	0.40	0.40
	FMT	6.9	5.8	10	7	1.45	1.21
Fri	PMT	5	5	2	2	0.40	0.40
	FMT	7	7	10	9	1.43	1.29
Mon	PMT	5	5.2	2	2	0.40	0.38
	FMT	9	9.2	9	9	1.00	0.98
Tues	FMT	8	7.5	3	1	0.38	0.13
	FMT	6.4	6.6	13	13	2.03	1.97
Wed	FMT	7.5	7	17	16	2.27	2.29
	PMT	5	5	3	3	0.60	0.60
Thur	FMT	6.9	6.9	11	11	1.59	1.59
	PMT	5	5.1	2	2	0.40	0.39
Fri	FMT	9	8.8	14	14	1.56	1.59
	PMT	5	4.9	3	3	0.60	0.61

Figure 4 - Two-Week Sample Flying Schedule

In this theoretical schedule, it is important to note that there is one day where two FMTs flew. The second FMT lists 13 students. However, the first FMT has only three students. These students, when checked against the original data sat, were two pilots and one navigator. If we could substitute a PMT for this FMT, the sortie would need about 5 hours for completion (vs. 7.5) saving approximately 2.5 hours. At $7,502 CPFH, this is just under $20,000. We continued this analysis through the entire data set and found 11 flying days in which two FMTs flew on the same day.

Once the sample flying schedule was completed, we averaged the daily PFT/Sortie for FMTs/PMTs and sortie duration for FMTs/PMTs. Table 5 outlines theses results.

Table 5 - PFT/Sortie and ASD

Average PFT/Sortie and Average Sortie Duration (ASD)		
	PFT/Sortie	**Average Sortie Duration (Hrs)**
FMTs	8.16	6.71
PMTs	1.78	4.60

Student Productivity

Next, we obtained grade books from 13 students. All students were IQT copilots or pilots. Grade books record how many events a student accomplishes, the grade for each event and then totals the final amount. Here, we closely examined how many events pilots accomplished on a FMT and PMT. We did not have to use the methodology described earlier to determine if a sortie was a PMT or FMT; grade books clearly list if a sortie is a FMT or PMT. The grade books did overlap some of the original flying data described in the earlier section. As shown in Table 6, although the pilot flying data is not strictly from the original data set, the ASD per FMT and PMT closely match the ASD per FMT and PMT from the original 100 sorties.

Table 6 - ASD Between Data Sets

Average Sortie Duration (ASD)		
	338th CTS 100 Sorties	**13 Pilot Grade books**
FMTs	6.71	7.05
PMTs	4.60	4.65

We counted total events, transition events and air refueling events. Transition events related solely to takeoff and landing maneuvers. Once recorded, we then classified the events as PMT Events/Flight or FMT Events/Flight. Once we had examined all 13 students across 100 sorties (44 PMTs/46 FMTs), we could identify, on average, how many events a pilot accomplished on a FMT or PMT. Figure 5 and Figure 6 show examples of this data.

TRAINING EVENT/TASK LISTING		# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE	# ACCM	GRADE
INFLIGHT TRAINING EVENTS / TASKS																					
P360	Mission Planning/Briefing	5	2	1	2	1	3	1	3			1	3			1	3	1	3
P361	Preflight	6	2	1	2	1	2	1	3			1	2			1	3	1	3
P366	Checklist Procedures	19	2	1	2	1	3	1	2			1	2			1	3	1	3
P367	Crew Coordination	9	2	1	2	1	2	1	2			1	2	1	3	1	3	1	4
	Airmanship/Discipline/SA	9	2	1	2	1	2	1	3			1	2	1	3	1	3	1	3
P369	Aircraft Equipment Ops	8	2	1	2	1	3	1	3			1	3			1	3	1	3
N203	FMS	17	2	1	2	1	3	1	3			1	3			1	3	1	3
TO01	Takeoff-Initial	24	2	1	3											1	3	1	3
P015	Instrument (IFR) Departure	4	2	1	3											1	3	1	3
TO40	Takeoff Sim Eng Failure	5	0	1	2							1	3						
P240	Landing Gear Alt Extension	4	2			1	3	1	2							1	3		
AR01	Receiver A/R Day	4	0.3	1	2	1	3	1	3							1	4	1	3
AR02	Receiver A/R Night	1	0.2											1	3				
R050	Rec A/R-Tanker Auto Off	0	0			1	3												
P101	Approach - ILS	25	3	2	3	1	3	2	3			1	3	1	3	1	3	2	3
P112	Approach TAC/VOR/LOC	9	2	1	3	1	3	1	3			2	3			1	3	1	3
	Approach - GPS	4	0.3	1	3														
AP23	Approach Visual Traf Pat	11	2	1	3	3	2					4	3			2	3	1	3
P160	Approach - Missed	12	2	1	2	1	3	1	3			1	3			1	3	1	3
P170	App & Go Sim Eng Out	5	0	1	2			1	3			2	2	1	3	1	3	1	3
LD21	App & Land Sim Eng Out	8	0.3	2	3	1	3					1	3			1	3	1	3
LD01	Landing - Day	51	2	4	2	2	2	1	3							4	3	3	3
LD02	Landing - Night	0	0			3	3	1	3			6	3						
P194	Landing - 30 Degrees Flap	3	0									2	3						
LD22	Landing, Full Stop Procd	6	2			1	3					1	3			1	3		
P199	Opposite Seat Landing	0	0					2	3			2	3			3	3	1	3
LD03	Landing T&G Procd	14	2	4	2	5	3	2	3			4	3			2	3		
P210	T/G Landing PNF Duties	14	0.3									1	2	1	3	1	3	1	3
	Total Events			28		28		20				35		6		29		22	
	Transition Events			20		19		12				28		3		21		14	
	A/R Events			1		2		1				0		1		1		1	

Figure 5 - PMT and FMT Event Summations

PMTs	44
FMTs	46

PMT/FMT Cost
$7,502/Hr

Student	Flt Number	Type	Sortie Duration	Total Events	Trx Events	A/R Events	Total Events/Hr	Trx Events/Hr	A/R Events	TOTAL EVENTS PMT Events	TOTAL EVENTS FMT Events
Student 7	1	FMT	6.4	21	14	0	3.28	2.19	0.00		21.00
Events 189	2	PMT	5.6	28	20	1	5.00	3.57	0.18	28.00	
Hrs 49.4	3	FMT	7.7	28	19	2	3.64	2.47	0.26		28.00
	4	FMT	7.5	20	12	1	2.67	1.60	0.13		20.00
	5	PMT	3.1	35	28	0	11.29	9.03	0.00	35.00	
	6	PMT	4.5	6	3	1	1.33	0.67	0.22	6.00	
	7	FMT	7.8	29	21	1	3.72	2.69	0.13		29.00
	8	FMT	6.8	22	14	1	3.24	2.06	0.15		22.00

Figure 6 - PMT and FMT Events per Sortie

The highlighted portion in Figure 6 corresponds to the highlighted numbers in Figure 5.

Once we totaled the Events per Sortie, we now had an average event count for PMTs and FMTs for the 13 students.

Table 7 - Pilot Events per FMT and PMT

	PMT Events	FMT Events
Average	23.15909	19.80435
Variation	50.69503	29.71643
Std Dev	7.12004	5.45128

Thus, on initial analysis, it appears pilots accomplish more events per sortie on PMTs vs. FMTs. The most likely reason is that pilots are more efficient when paired with other pilots. For example, if a math teacher had to teach linear algebra to 10 students who were previous math majors, that teacher could cover more material than if he taught 30 students with philosophy backgrounds. Also, flying FMTs normally involves some form of a trade-off. Not all students have equal priority. For example, when flying an FMT, it may be necessary to fly longer to complete a required flight evaluation. This may cut back on transition time at the end of the sortie.

Events Accomplished per PMT and FMT

Pilots accomplished more events on PMTs than FMTs. To see if this is a statistically significant difference, we conducted a simple single factor ANOVA test.

Table 8 - PMT vs. FMT Events per Sortie ANOVA

PMT vs FMT - Total Graded Events per Sortie - Columns M/N Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Column 1	44	1019	23.15909	50.69503171		
Column 2	46	911	19.80435	29.71642512		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	253.0967282	1	253.0967	6.332589529	0.013666911	3.949320841
Within Groups	3517.125494	88	39.96734			
Total	3770.222222	89				

$$\begin{gathered} H_O: \mu_{(FMT)} = \mu_{(PMT)} \\ H_A: \mu_{(FMT)} \neq \mu_{(PMT)} \\ F_{crit} = 3.95;\ F_{calc} = 6.33 \\ P_{value} = 0.014;\ \alpha = 0.05 \\ F_{crit} < F_{calc} \\ P_{value} < \alpha \end{gathered} \tag{2}$$

We can reject the null hypothesis and conclude there is a statistical significant difference between pilot events on PMTs vs. FMTs.

Events per Hour on PMT and FMT

In a similar way, pilots accomplished more events *per hour* on PMTs than FMTs. Again, we conducted a simple single factor ANOVA test.

Table 9 - PMT vs. FMT Events per Hour ANOVA

PMT vs FMT - Graded Events per Hour Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Column 1	44	229.0992434	5.206800985	4.821750522		
Column 2	46	128.7013372	2.797855157	0.494022278		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	130.503472	1	130.503472	50.02610049	3.46476E-10	3.949320841
Within Groups	229.5662749	88	2.60870767			
Total	360.069747	89				

$$
\begin{gathered}
H_O: \mu_{(FMT)} = \mu_{(PMT)} \\
H_A: \mu_{(FMT)} \neq \mu_{(PMT)} \\
F_{crit} = 3.94;\ F_{calc} = 50.03 \\
P_{value} < 0.001;\ \alpha = 0.05 \\
F_{crit} < F_{calc} \\
P_{value} < \alpha
\end{gathered} \tag{3}
$$

We can reject the null hypothesis and conclude there is a statistically significant difference between pilot events/hour on PMTs vs. FMTs.

IV. Analysis

Overview

Our final step is to take this data and apply it to the theoretical flying schedule. Here we will build a theoretical, basic schedule from the 11 FMT/FMT flying days and examine them to see if there are opportunities to be more efficient or productive with our flying operations.

Reflowing the Flying Schedule

In our theoretical schedule, we had 11 days in which the 338th flew two FMTs per day. All 11 pairs are together in a sample 11-day flying period in Figure 7. Each FMT is listed with the actual sortie duration. For a few sorties, the “Hrs” column appears to violate our PMT/FMT classification discussed in Table 4. However, each sortie listed, despite its final duration, was scheduled to fly more than 6 hours. Thus while it may appear “PMT” in nature, it is a “FMT”. The pilots per flight (“Pilots/Flt”) is located within the original 100-day data set from the 338th CTS. Pilot efficiency (“Pilot Events/Flt”) is the average obtained from the grade books. The original PFT per flight (“Original PFT/Flt”) is the number of PFT trained on that specific flight

For our analysis, we will assume the first FMT maximizes student training and cannot accept more students. Thus, our emphasis is on the second sortie. For example on Day 1 (highlighted with red box) in Figure 7, the second sortie flew for 7.2 hours yet only produced 2 pilot PFT. If we use the Pilot Events per FMT average, each pilot accomplishes 19.8 events on this particular sortie (39.61 events total). Since the sortie flew for 7.2 hours at $7,502/hr, this sortie used approximately $54,000 of the flying budget. This analysis continues through all 22 sorties and displayed in Figure 7.

Total costs, hours and PFT accomplished are at the bottom of the Figure 7. Total pilot events are at the bottom as well. In analyzing the 13 grade books, on average, pilots accomplished 148 events before graduating the program. If we use this number as an average and divide it by the total events listed, approximately 2.54 pilots would have enough training to complete the program.

ORIGINAL SCHEDULE

DAY	Type	Hrs	Cost/Flt	Pilot Events/Flt	Original PFT/Flt	Pilots/Flt	Total Events
1	FMT	8.80	$66,017.60	19.80	16		
	FMT	7.20	$54,014.40	19.80	3	2	39.61
2	FMT	8.20	$61,516.40	19.80	19		
	FMT	5.20	$39,010.40	19.80	3	2	39.61
3	FMT	5.50	$41,261.00	19.80	11		
	FMT	5.20	$39,010.40	19.80	7	2	39.61
4	FMT	7.30	$54,764.60	19.80	14		
	FMT	6.90	$51,763.80	19.80	9	2	39.61
5	FMT	6.60	$49,513.20	19.80	11		
	FMT	7.00	$52,514.00	19.80	8	1	19.80
6	FMT	5.90	$44,261.80	19.80	10		
	FMT	6.00	$45,012.00	19.80	1	1	19.80
7	FMT	5.90	$44,261.80	19.80	11		
	FMT	6.40	$48,012.80	19.80	9	2	39.61
8	FMT	6.60	$49,513.20	19.80	13		
	FMT	7.50	$56,265.00	19.80	1	1	19.80
9	FMT	9.10	$68,268.20	19.80	20		
	FMT	7.20	$54,014.40	19.80	2	2	39.61
10	FMT	7.00	$52,514.00	19.80	5		
	FMT	7.20	$54,014.40	19.80	3	2	39.61
11	FMT	6.70	$50,263.40	19.80	12		
	FMT	6.90	$51,763.80	19.80	8	2	39.61

Total Cost	$1,127,550.60	Total Events	376.28
Total Hrs	150.30	Pilots generated	2.54
Total PFT	196		

Figure 7 - FMT/FMT Flying Schedule

In analyzing the schedule, we want to see if a PMT would be more efficient as the second sortie. If we substitute a PMT for the second sortie, our ASD decreases and pilot productivity increases from 19.8 Events/Flt to 23.1 Events/Flt. By decreasing the sortie duration by about 2.5 hours, the sortie costs approximately $34,000. If we compare Day 1's second sortie from Figure 7 with Day 1's second sortie from Figure 8, we see the following differences in Table 10.

Table 10 - Day 1's Second Sortie FMT vs. PMT

Day 1 Second Sortie	Hrs Flown	Pilot Events/Flt	Total Pilot Events	Cost	PFT Completed
FMT	7.2	19.8	39.6	$54,014.40	3
PMT	4.6	23.1	46.3	$34,509.20	3

By simply changing Day 1's second sortie to a PMT, almost $20,000 less is spent on flying. Furthermore, the crew is more productive as the "Total Pilot Events" increases by 6.7 events. Overall, it appears crew productivity is increased and flying is more efficient without any loss in "PFT Completed".

We continue this process for all available sorties. Figure 8 on the following page displays the results. Any FMT with three students or less (students are confirmed pilots or navigators) is substituted with a PMT. For ease of viewing, all FMT/PMT combinations are first, followed by FMT/FMT combinations. For example, we swapped days 3 and 10. Day 3 was originally FMT/FMT but then reflowed as a FMT/PMT. The original Day 3 FMT/FMT moved to Day 10 and kept as a FMT since the second sortie had more than 3 students on board and scheduled for greater than 6 hours. A line is drawn after Day 6 to represent a change from FMT/PMT to FMT/FMT.

ADJUSTED SCHEDULE WITH PMTs								
DAY	Type	Hrs	Cost/Flt	Pilot Events/Flt	Original PFT/Flt	Chg 1 PFT/Flt	Pilots/Flt	Events
1	FMT	8.80	$66,017.60	19.80	16	16		
	PMT	4.60	$34,509.20	23.16	3	3	2	46.32
2	FMT	8.20	$61,516.40	19.80	19	19		
	PMT	4.60	$34,509.20	23.16	3	3	2	46.32
3	FMT	5.50	$41,261.00	19.80	11	5		
	PMT	4.60	$34,509.20	23.16	7	3	2	46.32
4	FMT	7.30	$54,764.60	19.80	14	20		
	PMT	4.60	$34,509.20	23.16	9	2	2	46.32
5	FMT	6.60	$49,513.20	19.80	11	13		
	PMT	4.60	$34,509.20	23.16	8	1	1	23.16
6	FMT	5.90	$44,261.80	19.80	10	10		
	PMT	4.60	$34,509.20	23.16	1	1	1	23.16
7	FMT	5.90	$44,261.80	19.80	11	11		
	FMT	6.40	$48,012.80	23.16	9	9	2	46.32
8	FMT	6.60	$49,513.20	19.80	13	11		
	FMT	7.50	$56,265.00	19.80	1	8	2	39.61
9	FMT	9.10	$68,268.20	19.80	20	14		
	FMT	7.20	$54,014.40	19.80	2	9	2	39.61
10	FMT	7.00	$52,514.00	19.80	5	11		
	FMT	7.20	$54,014.40	19.80	3	7	2	39.61
11	FMT	6.70	$50,263.40	19.80	12	12		
	FMT	6.90	$51,763.80	19.80	8	8	2	39.61

Total Cost	$1,053,280.80	Total Events	436.34
Total Hrs	140.40	Pilots generated	2.95
Total PFT	196	Pilot Δ	0.41

	Savings
Money	$74,269.80
Hours	9.90
PFT	0

Figure 8 - FMT/PMT Flying Schedule Chg 1

Initial cost and hour avoidance are at the bottom of Figure 8. By using 6 PMTs instead of 6 FMTs, the 338th CTS can avoid using about 10 hours and almost $75,000 (Each flight hour, regardless of PMT or FMT, is multiplied by the current CPFH of $7,502). Since PMTs yield a higher pilot production rate, pilot efficiency is increased. The "Pilot Δ" compares "Pilots generated" in Figure 7 and Figure 8 and shows an increase of pilots produced for less hours and cost than the original schedule.

Cancelling Specific Flights

Finally, if given the option to cancel sorties, a commander could cancel sorties and not decrease overall flying production. In this scenario, a commander could use the FMT/PMT Flying Schedule Chg 1 in Figure 8 and cancel the two PMTs with only one pilot. While this decreases the total PFT accomplished in the given time period, it does not hurt overall pilot productivity compared to the original flying schedule in Figure 7. The results of cancelling sorties are shown in Figure 9. The summary statistics between the three flying schedules is below in Table 11.

Table 11 - Summary Statistics Between Schedules

	Cost	Hours Flown	Total PFT	Pilot Events	Pilots Produced	Pilot Delta
FMT/FMT Schedule	$1,127,550.60	150.30	196	376.28	2.54	n/a
FMT/PMT Schedule Chg 1	$1,053,280.80	140.40	196	436.34	2.95	+ 0.41
FMT/PMT Schedule Chg 2	$984,262.40	131.2	194	390.03	2.64	+ 0.09

ADJUSTED SCHEDULE WITH PMTs and CANXs									
DAY	**Type**	**Hrs**	**Cost/Flt**	**Pilot Events/Flt**	**Original PFT/Flt**	**Chg 1 PFT/Flt**	**Chg 2 PFT/Flt**	**Pilots/Flt**	**Events**
1	FMT	8.80	$66,017.60	19.80	16	16	16		
	PMT	4.60	$34,509.20	23.16	3	3	3	2	46.32
2	FMT	8.20	$61,516.40	19.80	19	19	19		
	PMT	4.60	$34,509.20	23.16	3	3	3	2	46.32
3	FMT	5.50	$41,261.00	19.80	11	5	5		
	PMT	4.60	$34,509.20	23.16	7	3	3	2	46.32
4	FMT	7.30	$54,764.60	19.80	14	20	20		
	PMT	4.60	$34,509.20	23.16	9	2	2	2	46.32
5	FMT	6.60	$49,513.20	19.80	11	13	13		
CANX	**PMT**	**0.00**	**$0.00**	**23.16**	**8**	**1**	**0**	**0**	**0.00**
6	FMT	5.90	$44,261.80	19.80	10	10	10		
CANX	**PMT**	**0.00**	**$0.00**	**23.16**	**1**	**1**	**0**	**0**	**0.00**
7	FMT	5.90	$44,261.80	19.80	11	11	11		
	FMT	6.40	$48,012.80	23.16	9	9	9	2	46.32
8	FMT	6.60	$49,513.20	19.80	13	11	11		
	FMT	7.50	$56,265.00	19.80	1	8	8	2	39.61
9	FMT	9.10	$68,268.20	19.80	20	14	14		
	FMT	7.20	$54,014.40	19.80	2	9	9	2	39.61
10	FMT	7.00	$52,514.00	19.80	5	11	11		
	FMT	7.20	$54,014.40	19.80	3	7	7	2	39.61
11	FMT	6.70	$50,263.40	19.80	12	12	12		
	FMT	6.90	$51,763.80	19.80	8	8	8	2	39.61

Total Cost	$984,262.40	Total Events	390.03
Total Hrs	131.20	Pilots generated	2.64
Total PFT	194	Pilot Δ	0.09

	Savings
Money	$143,288.20
Hours	19.10
PFT	-2

Figure 9 - FMT/PMT Flying Schedule Chg 2

Reflowing the Flying Schedule with Data Averages

We can do the same analysis with data averages as well. On the following pages, if we substitute sortie duration and PFT/Flt with averages from the 100 sorties, evidence still exists that PMTs and specific cancels can improve flying efficiency.

ORIGINAL SCHEDULE

DAY	Type	Hrs	Cost/Flt	Pilot Events/Flt	Original PFT/Flt	Pilots/Flt	Total Events
1	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	1.78	35.25
2	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	1.78	35.25
3	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	1.78	35.25
4	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	1.78	35.25
5	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	1.78	35.25
6	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	1.78	35.25
7	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	1.78	35.25
8	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	1.78	35.25
9	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	1.78	35.25
10	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	1.78	35.25
11	FMT	6.71	$50,338.42	19.80	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	1.78	35.25

Total Cost	$1,107,445.24	Total Events	387.77
Total Hrs	147.62	Pilots generated	2.62
Total PFT	141.24		

Figure 10 - FMT/FMT Flying Schedule w/Averages

ADJUSTED SCHEDULE WITH PMTs

DAY	Type	Hrs	Cost/Flt	Pilot Events/Flt	Original PFT/Flt	Chg 1 PFT/Flt	Pilots/Flt	Events
1	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	1.78	1.78	1.78	41.22
2	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	1.78	1.78	1.78	41.22
3	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	8.16	1.78	1.78	41.22
4	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	8.16	1.78	1.78	41.22
5	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	8.16	1.78	1.78	41.22
6	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	1.78	1.78	1.78	41.22
7	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	FMT	6.71	$50,338.42	23.16	8.16	8.16	1.78	41.22
8	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	8.16	1.78	35.25
9	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	8.16	1.78	35.25
10	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	8.16	1.78	35.25
11	FMT	6.71	$50,338.42	19.80	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	8.16	1.78	35.25

Total Cost	$1,012,469.92	Total Events	429.57
Total Hrs	134.96	Pilots generated	2.90
Total PFT	141.24	Pilot Δ	0.28

	Savings
Money	$94,975.32
Hours	12.66
PFT	0

Figure 11 - FMT/PMT Flying Schedule Chg1 w/Averages

ADJUSTED SCHEDULE WITH PMTs and CANXs									
DAY	Type	Hrs	Cost/Flt	Pilot Events/Flt	Original PFT/Flt	Chg 1 PFT/Flt	Chg 2 PFT/Flt	Pilots/Flt	Events
1	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	1.78	1.78	1.78	1.78	41.22
2	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	1.78	1.78	1.78	1.78	41.22
3	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	8.16	1.78	1.78	1.78	41.22
4	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	8.16	1.78	1.78	1.78	41.22
5	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
CANX	PMT	0.00	$0.00	23.16	8.16	1.78	0	0	0.00
6	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	PMT	4.60	$34,509.20	23.16	1.78	1.78	1.78	1.78	41.22
7	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	FMT	6.71	$50,338.42	23.16	8.16	8.16	8.16	1.78	41.22
8	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	8.16	8.16	1.78	35.25
9	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	8.16	8.16	1.78	35.25
10	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	1.78	8.16	8.16	1.78	35.25
11	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16		
	FMT	6.71	$50,338.42	19.80	8.16	8.16	8.16	1.78	35.25

Total Cost	$977,960.72	Total Events	388.35
Total Hrs	130.36	Pilots generated	2.62
Total PFT	139.46	Pilot Δ	0.00

	Savings
Money	$129,484.52
Hours	17.26
PFT	-1.78

Figure 12 - FMT/PMT Flying Schedule Chg2 w/Averages

The summary statistics (with data averages) is shown in Table 12.

Table 12 - Summary Statistics Between Schedules w/Averages

	Cost	Hours Flown	Total PFT	Pilot Events	Pilots Produced	Pilot Delta
FMT/FMT Schedule	$1,107,455.24	147.62	141.24	387.77	2.62	n/a
FMT/PMT Schedule Chg 1	$1,012,469.92	134.96	141.24	429.57	2.90	+ 0.28
FMT/PMT Schedule Chg 2	$977,960.72	130.36	139.46	388.35	2.62	+ 0.00

Applying Incremental Changes

In reflowing the flying schedule, there appears to be opportunities to increase flying efficiency and productivity. Three different approaches are available. It is important to note the 338th may not be able to use these hours. In this case, a commander may be able to allow other squadrons to use the available hours for training.

1) Use FMTs - If we compare Figure 7 and Figure 9, the 338th CTS could save 19.1 hours over the course of 100 flights. To illustrate how this can be important, let's assume this data set represented three months of flying. If we use the original data set as 25% of the overall flying for the fiscal year, the 338th CTS could identify 76.4 hours for improvement (19.1 x 4 = 76.4).

If the 338th CTS were to use the extra 76.4 just for flying additional FMTs, the gains could be substantial. However, the 338th CTS may not have the capability to fly FMT/FMT on a constant basis but may have the capability to do this on an occasional basis. If the average FMT sortie duration is used, the 338th CTS could fly an additional 11 FMTs per year (less than 1 additional sortie per month).

$$76.4 \; available\ hours \; \div 6.71 \; average\ sortie\ duration = 11.38 \; FMT\ flights \tag{4}$$

Furthermore, if we take the average PFT accomplished per flight and multiply this by the additional FMTs, the 338th CTS could have the capacity to train approximately 98 more students.

$$11.38 \; FMTs \; x \; 8.61 \frac{PFT}{FMT} = 98.03 \; additional\ PFT \tag{5}$$

Recalling “Table 2 - Extra PFT per Week”, the number of additional crewmembers could be substantial. For example, if we used the number of PFT required to graduate an AC, CP and Nav, the 338th CTS would have the capacity to produce at least an additional two crewmembers at each position. This is shown in Table 13.

Table 13 - Additional Capacity

Additional Capacity		
Position	**PFT Required**	**Two Crewmembers**
AC	8	16
CP	8	16
Nav	7	14
Total	23	46

2) Use PMTs - Conversely, if the 338th CTS wanted to strictly use their PMTs for the available hours, they would still see an increase in production. With an additional 76.4 hours, a commander could schedule 16 PMTs or approximately 1 extra PMT per month.

$$76.4\ hours\ \div 4.6\ average\ sortie\ duration = 16.6\ PMT\ flights \qquad (6)$$

Again, we take the average PFT accomplished per flight and multiply this by the additional FMTs, the 338th CTS could train approximately 29 more students. Essentially, this extra capacity could yield an additional AC, CP and Nav.

$$16.6\ FMTs\ x\ 1.78\frac{PFT}{PMT} = 29.6\ additional\ PFT \qquad (7)$$

3) Not Fly - A third, and somewhat more controversial, method exists. A commander could choose to not reschedule the sortie. In both scenarios, with average ASD and actual sortie duration, the overall reduction in PFT is 2 or less at a cost avoidance of at least $129,000. If nothing else, by not flying, a commander has put less stress on his aircrew, maintenance and aircraft. If a commander and operational squadrons can accept this PFT decrement, choosing “Not Fly” is probably the most cost effective measure in these scenarios.

V. Conclusion

By analyzing flying data, one can determine where training is most effective. By simply tracking pilot performance, analyzing a flying schedule over multiple classes and months yielded insights into how to effectively use PMTs in the FTU flying schedule.

While it may be necessary to fly a FMT/FMT schedule occasionally, the second sortie will begin to show large inefficiencies with respect to hours flown, students trained and cost compared to a PMT profile. In general, consecutive days of FMT/FMT flying will result in excess costs and hours flown.

To alleviate this problem, FMTs should not be used when a student crew consists of only pilots and navigators. Furthermore, if only one student pilot is loaded on the sortie, strong consideration should be given towards cancelling that specific sortie. The flying schedule will allow the FTU to allocate those hours towards another sortie later in the calendar year.

Future research in this area should include a better determination of the CPFH for PMTs. It should then use the new CPFH and compare it with training accomplished. Ultimately, there needs to be a method that can accurately compare the amount of training per hour on an FMT vs. PMT despite the different crew make-up. Finally, a minimum PFT per hour metric should be established for PMTs and FMTs that will aid commanders in their reschedule decision.

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Vita

Major John J. Isacco graduated from Greenville High School, Greenville, Pennsylvania, in 1997. He earned a Bachelor of Science degree in Economics with a minor in Russian at the United States Air Force Academy in 2001. Major Isacco earned a Master's in Public Administration from the University of Oklahoma in 2009.

Before pilot training, Major Isacco worked as an Executive Officer for the 15th Airlift Squadron at Charleston AFB, Charleston, SC. Major Isacco attended Euro-NATO Joint Jet Pilot Training at Sheppard AFB in Wichita Falls, Texas in 2002. In 2004, Maj Isacco was assigned to the 960th Airborne Air Control Squadron, Tinker AFB, Oklahoma. He participated in Operations IRAQI FREEDOM and ENDURING FREEDOM and served as an aircraft commander, instructor pilot and flight commander. Major Isacco moved to the 966th Airborne Air Control Squadron (E-3 FTU), Tinker AFB, Oklahoma and served as PFT Chief.

In September 2009, Major Isacco PCS'd to Offutt AFB, Omaha, Nebraska. Major Isacco served in the 343rd Reconnaissance Squadron as aircraft commander, instructor pilot and assistant director of operations. He participated in OEF/OIF and served as interim director of operations for the 763rd Expeditionary Reconnaissance Squadron. In September 2011, Major Isacco moved to the 338th Combat Training Squadron (RC-135 FTU) where he served as chief of training. In May 2012, Major Isacco entered the Graduate School of Engineering and Management, Air Force Institute of Technology, Wright-Patterson AFB, Ohio. Upon graduation, Major Isacco will move to Ramstein AB, Germany and work at NATO in Headquarters Allied Air Command.

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14. ABSTRACT

The process of training a student from their first sortie through their flight evaluation is called Program Flying Training (PFT). Initial Qualification Training, conducted by aircraft Flying Training Units (FTUs), provides operational squadrons with new aircrew. With a high and persistent demand, FTUs are under constant pressure to complete as much training as possible per day. This research seeks to determine where limited resources are best allocated to produce the same or greater number of qualified aircrew at a reduced cost. The method involves using Partial Mission Trainers (PMTs) where needed and giving commanders the flexibility to cancel sorties that are deemed inefficient.

This analysis will specifically examine RC-135 flying operations at Offutt AFB, Nebraska. Flying data from the 338th Combat Training Squadron (RC-135 FTU) is analyzed to determine where inefficiencies occur within the flying schedule. Once identified, the flying schedule can be reflowed to incorporate the use of PMTs. Furthermore, evidence exists that commanders can cancel specific sorties and not lose PFT productivity. By eliminating inefficient sorties and then rescheduling them later when more students are available, FTUs may be able to improve their PFT productivity.

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Cost Comparison

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